



ADVANCED MANUFACTURING

Engineering Directorate Technology Thrust Area

Marshall Space Flight Center (MSFC) • Huntsville, Alabama

Advanced Manufacturing is a high emphasis technology activity of the Engineering Directorate. The mission of this activity is to develop and enhance the advanced manufacturing technologies critical to the mission of NASA -- technology that provides safe, low-cost access to space. The Advanced Manufacturing technology thrust area works closely with MSFC's National Center for Advanced Manufacturing (NCAM). With prestigious partners such as the Army Aviation and Missile Command (AMCOM), and Government Agencies Technology Exchange for Manufacturing (GATE-M), the Advanced Manufacturing thrust area is creating a culture of collaborative engineering.



*Applications of FSW include the Space Shuttle
STS-75 Columbia launch, 1996*



Retractable Pin Tools for FSW

Technology Spotlight

Friction Stir Welding



Benefits - Friction Stir Welding (FSW) offers a wide range benefits over conventional fuse welds. Today the FSW process creates durable joints without keyholes and twice the fatigue resistance of fusion welds. Straight or complex shape welds can be created on a wide range of alloys, including previously unweldable and composite materials. FSW does not create hazards such as welding fumes, radiation, high voltage, liquid metals, or arcing. In addition, the FSW process can be performed at low cost with minimal operator expertise and training. Manufacturing applications for FSW include aircraft, space shuttle, and large fuel tank assembly.

Process - During the FSW process, the pin of a shouldered tool is slowly plunged into the joint between the two materials to be welded and rotated at a high speed. The resulting friction creates a plasticized shaft of material around the pin. As the pin moves forward in the joint, it "stirs" or crushes the plasticized material, creating a forged bond.

Innovations at MSFC - Solutions to some of the early drawbacks of FSW have been developed by the Advanced Manufacturing team. Original FSW processes relied on a pin tool that left a keyhole in the joint. The automatic retractable pin tool developed at MSFC uses a computer-controlled motor to automatically retract the pin into the shoulder of the tool at the end of the weld, preventing keyholes. Secondly, using the original FSW process, it was difficult to create reliable welds on cylindrical materials such as pipes or drums. MSFC has developed the Orbital Friction Stir Weld System, an apparatus for joining two cylindrical sections together with a friction stir weld, thus overcoming this problem.

Additional Advanced Manufacturing Technologies

Rapid Prototyping (RP)



MSFC employee using RP to make models from computer generated designs

Advanced Manufacturing uses Rapid Prototyping technology to expedite and improve design and manufacturing projects. In this context, Rapid Prototyping (RP) refers to a collective set of manufacturing technologies that fabricate three-dimensional models directly from computer data. This task is accomplished without the need for conventional fixtures or numerical control code generation. RP utilizes additive manufacturing techniques to build parts in thin layers from the bottom up, essentially “growing” a part in the selected material. In addition, RP works to improve existing systems’ materials capabilities and to develop and refine secondary applications, such as investment casting and soft tooling. Futuristic RP technology may be applied to manufacturing in space and on other planets.

National Center for Advanced Manufacturing (NCAM)



Fiber Placement Activity

The Advanced Manufacturing thrust area is one of the efforts of the **National Center for Advanced Manufacturing (NCAM)**. NCAM develops new manufacturing techniques and improves upon existing manufacturing methods used in space transportation and propulsion systems. This work is achieved through partnerships with industry, academia, and government agencies. NCAM currently consists of five adjacent facilities located at MSFC as part of the Materials, Processes, and Manufacturing Department. Team members and partners collaborate on a wide range of technologies, including composite assembly, kinematics, and rapid prototyping.

A partnership between the State of Louisiana and MSFC has created an NCAM satellite manufacturing facility at the Michoud Assembly Facility in New Orleans. Through funding from the Louisiana Department of Economic Development, state-of-the-art equipment has been purchased to conduct research and train a skilled workforce in new manufacturing techniques. The two areas of concentration are Fiber Placement of large composite structures and advances in Friction Stir Welding. The University of New Orleans acts as the administrator of the partnership for the state and has further formed a consortium of four other universities to conduct research in advanced manufacturing for future space transportation systems.

